United States
Department of
Agriculture
Forest Service

Forestry Research West

SD11
.F6

December 1997

ROCKY MOUNTAIN RESEARCH STATION LIBRARY
FORT COLLINS CENTER
240 W PROSPECT RD
FORT COLLINS, CO 80526-2098

A report for land managers on recent developments in forestry research at the three western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

In This Issue

Fire, Logging, and Grazing Impacts on Southwestern Birds.....1

Trees and Logs Important for Wildlife Habitat.....7

New From Research.....12

Cover

Forest trees, both living and dead, provide important habitat for a variety of wildlife, such as this northern goshawk and her young. Scientists at the Pacific Northwest Research Station have authored a new publication that provides information on the value of tree structures to wildlife, the decay or infection process involved in the formation of these structures, and the principles to consider for selecting which trees to retain during planning. Details begin on page 7. (drawing by Susan Lindstedt)

To Order Publications

Single copies of publications referred to in this magazine are available without charge from the issuing station unless another source is indicated. See page 15 for ordering cards.

Each station compiles periodic lists of new publications. To get on the mailing list, write to the director at each station (addresses on ordering cards).

To change address, notify the magazine as early as possible (address on outside back cover). Send mailing label from this magazine and new address. Don't forget to include your Zip Code.

Permission to reprint articles is not required, but credit should be given to the Forest Service, U.S.D.A.

Mention of commercial products is for information only. No endorsement by the U.S.D.A. is implied.

The United States Department of Agriculture prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. Persons with disabilities who require alternative means for communication of program information should contact the USDA Office of Communications at (202) 720-2791 (voice) or (800) 855-1234 (TDD). To file a complaint, write the Secretary of Agriculture, USDA, Washington, D.C. 20250, or call (800) 245-6340 (voice) or (800) 855-1234 (TDD). USDA is an equal employment opportunity employer.

Western Forest Experiment Stations

Pacific Northwest Research Station (PNW)
333 S.W. First Avenue
Portland, Oregon 97204

Pacific Southwest Research Station (PSW)
P.O. Box 245
Berkeley, California 94701

Rocky Mountain Research Station (RMRS)
240 West Prospect Road
Fort Collins, Colorado 80526-2098

Forestry Research West Writers and Editors:

Rick Fletcher
Rocky Mountain Research Station
240 W. Prospect Rd.
Ft. Collins, CO 80526

Dave Tippets
Rocky Mountain Research Station
324 25th St.
Ogden, UT 84401

Sherri Richardson
Pacific Northwest Research Station
333 S.W. First Ave.
Portland, OR 97204

Connie Gill
Pacific Southwest Research Station
P.O. Box 245
Berkeley, CA 94701

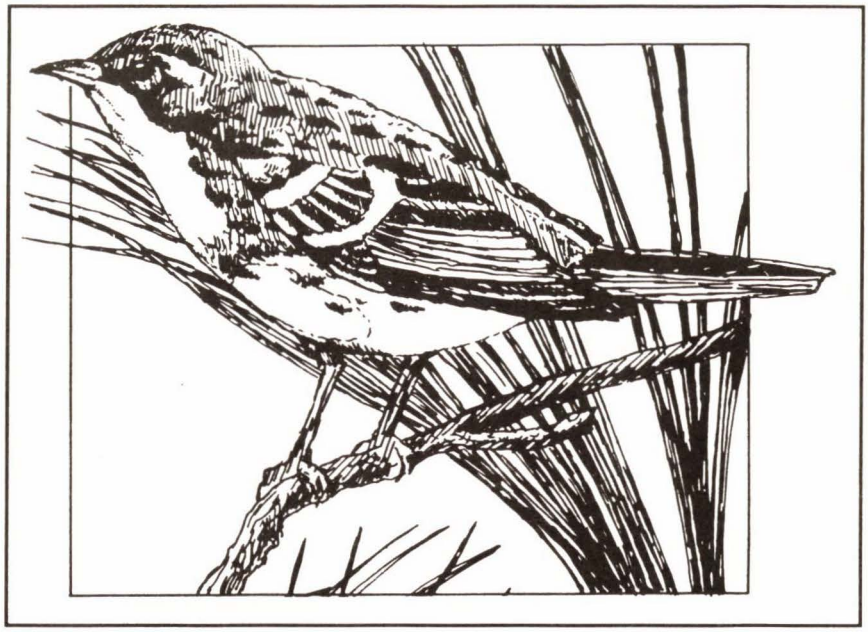
Fire, Logging, and Grazing Impacts on Southwestern Birds

Edited by Rick Fletcher, Rocky Mountain Research Station

(The following article is based on a research highlight from the publication Songbird Ecology in Southwestern Ponderosa Pine Forests: A Literature Review, *General Technical Report RM-292).*

Several land management practices influence habitats, reproduction, and population levels of birds that live in the ponderosa pine forests of the southwestern U.S. These forests are home to a variety of birds living in diverse forest conditions that have resulted from past and present human use and other factors.

Scientists Deborah Finch and Joseph Ganey, with the Rocky Mountain Research Station, along with researchers Wang Yong (University of Rhode Island), Rebecca Kimball (University of New Mexico), and Rex Sallabanks (Sustainable Ecosystems Institute, Meridian, ID), have reviewed the results of past and more recent studies evaluating factors that influence bird numbers, species diversity, nesting success, and habitat use. They looked at three of the most widespread management practices: fire, logging, and grazing.



Grace's warbler

Fire

"Fire can affect forest birds directly or indirectly, positively or negatively," says Joseph Ganey, Research Wildlife Biologist at the Southwest Forest Science Complex in Flagstaff, AZ. "Fires can affect birds through habitat modification, changes in food supply, or changes in the number of competitors and/or predators," he says. Studies show that large fires generally affect more habitat and therefore more birds than do small fires. A stand-replacing fire may result in many or most of the species present before the fire being replaced by a new species. In contrast, cool understory burns may have little affect on species composition.

Although large, intense burns greatly alter bird habitat in the short-term, they may be necessary for long-term maintenance of natural forest succession patterns of some forest types or for habitat diversity in others.

"Less is known about the effects of fire on birds in ponderosa pine forests than about the effects of fire on forest birds in general," says Ganey. "Because fire is an important natural process in Southwestern ponderosa pine forests, communities of forest birds are well-adapted to cope with the natural fire regime in these forests. Disruption of that fire regime, however, along with grazing, timber harvest, and fuelwood cutting, has caused pronounced structural changes in these forests. As a result, wildfires today may burn more intensely and over larger areas than historical fires, which could have significant negative effects on communities of forest birds and their habitats," he says.

One study sampled birds in northern Arizona ponderosa pine forests that had undergone stand-replacing fires at various times. Scientists found dramatic increases in populations of ground-foraging birds immediately after the fires, followed by a gradual decline as canopy cover increased. Timber-drilling birds also increased in burned areas, apparently in response to increased numbers of wood-boring insects. Timber-gleaning or bark-foraging birds decreased following fire, with populations remaining depressed for up to 20 years. Tree-foliage-searching birds increased immediately after fire, then declined dramatically over time.

Another study compared breeding bird communities on an unburned site with those on 3 sites burned by wildfire and salvage-logged on the Coconino National Forest in northern Arizona. Bird communities on burned sites were dominated by ground-foraging birds. Large snags on burned areas were used for nesting by numerous woodpeckers, nuthatches, bluebirds, and house wrens. Although the unburned site contained the greatest richness and abundance of birds, the sites together housed more species than any single unit. Ganey says that, although avian diversity might be reduced on an individual burn, the patchiness caused by burns across the landscape appears to enhance avian diversity.

Ganey believes that, given current forest conditions, restoring natural fire regimes will require substantial increases in prescribed burning to reduce fuel loads. Limited evidence on the effects of prescribed fire on forest birds and their habitat suggests that important habitat components of forest birds may be affected by prescribed fire, at least in the short term. "To avoid large-scale loss of important habitat components, special techniques, including thinning dense stands and creating fire lines for snags and logs, may be required to reintroduce fire into areas where it has been excluded," says Ganey.

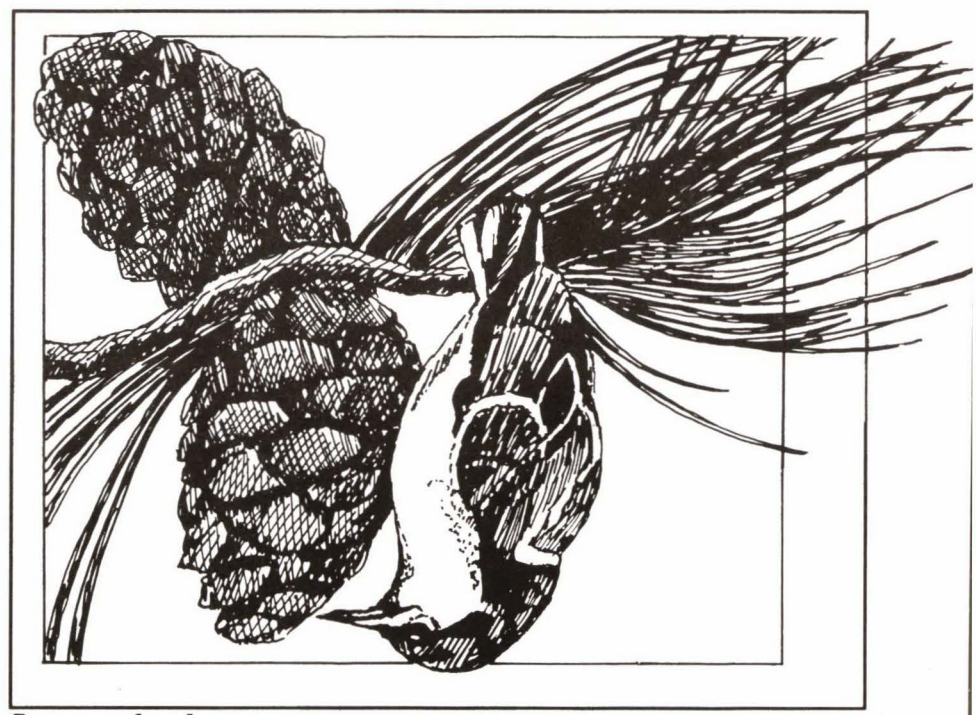
Logging

In the Southwest, logging and other types of silviculture have affected the availability, structure, age, and composition of stands. Such changes have potentially affected the number and distribution of bird populations using ponderosa pine habitats. Logging practices alter forest habitats by: 1) shortening the grass-forb and shrub stage; 2) creating an even-aged monoculture; 3) eliminating snags; and 4) eliminating old-growth.

The most extensive series of studies about bird responses to ponderosa pine logging in the Southwest were conducted on the Beaver Creek Watershed in central Arizona during the late 1970's and 1980's. Scientists compared species diversity and relative abundance of birds among different timber management practices: 1) clearcut (removal of all commercial woody vegetation); 2) severely thin (removal of most of the timber stock); 3) strip cut (alternate strips thinned to improve production); and 4) silviculturally cut (mature and old trees selectively cut).

Because clearcuts and strip cuts are now uncommon in the Southwest, the Beaver Creek Watershed study is a historical study rather than a current standard.

Compared to a control plot, researchers found that bird abundance and species diversity was lower on the clearcut and severely-thinned plots, but higher on strip cut and silviculturally cut plots. Rock wren, American robin, dark-eyed junco, spotted towhee, northern flicker, and mountain bluebird used the clearcut plot, but only rock wren and spotted towhee were favored by clearcutting. On the other hand, removal of some mature and old ponderosa pines using strip cuts and silvicultural cuts favored house wren, solitary vireo, yellow-rumped warbler, Grace's warbler, rock wren, American robin, chipping sparrow, white-breasted nuthatch, western wood-pewee, and western bluebird. The uncut control plot had higher abundances of pygmy nuthatch, red-faced warbler, hermit thrush, western flycatcher, and violet-green swallow.



Pygmy nuthatch

Researchers conclude that openings generated by logging can result in major shifts in local availability of habitats for a given bird species, and might be a primary factor in the selection of breeding sites. "Those species that typically used more open habitats were most abundant on either medium or heavy cuts," says Deborah Finch, Project Leader at the Forestry Sciences Laboratory in Albuquerque, NM. "Species that prefer dense foliage were less abundant in more modified habitats. Of the 15 species found on all forested plots, 33 percent had highest population densities on treated plots, suggesting preference for a more open canopy," she says.

Studies on the effects of moderately heavy overstory removal found that avian species richness was equal on the treated area and an adjacent unharvested area; however, overall abundance was significantly higher on the latter. Bird abundances on treated and untreated areas varied among species and guilds, probably reflecting differential responses to availability of foraging and nesting substrates. Thirteen species, primarily bark/foliage foragers and cup-nesters, were more abundant on the unharvested area, whereas 10 species of aerial and ground foragers were more abundant on the treated portion.

Grazing and Range Management Impacts

Livestock grazing in Southwestern ponderosa pine forests has been common since the 19th century, so it is likely that habitat changes due to grazing exist in most forested areas of the Southwest. These changes may alter species abundance and composition in avian and other wildlife communities.

"The mere presence of livestock does not mean that long-term habitat destruction is occurring," says Research Assistant Professor Rebecca Kimball. "Instead, the degree to which grazing affects the habitat, and hence the birds using that habitat, depends on several factors: 1) number of animals grazing in an area; 2) time of grazing; and 3) grazing system used. Greater habitat changes occur as grazing intensity increases," she says.

Grazing during the spring and early summer may directly decrease the reproductive success of breeding birds through destruction or disturbance of nests on the ground or in low shrubs. Kimball notes that grazing can also reduce the volume of grasses and, to a lesser extent, the forbs and shrubs, which form much of the understory vegetation. "Some bird species are only found in areas with dense understory vegetation," she says. "These are likely to decrease in abundance if the volume of vegetation is reduced. Since grazing alters plant species composition, reduces the number of species in the understory, and decreases the volume of the understory,

changes in bird abundances, compositions, and richness of songbird species may occur in forests that are heavily grazed."

Structure and composition of the understory is also important for foraging. Seeds and berries, many of which are produced by understory vegetation, are critical to many bird species. When grazing changes the quantity and composition of the understory, the amount of available food for some species also changes.

Insects are also an important food source for songbird species, as they are the primary food for offspring. Abundance and species composition of insects may be affected by changes in the understory, as many insect species depend on specific plants to provide food and oviposition sites.

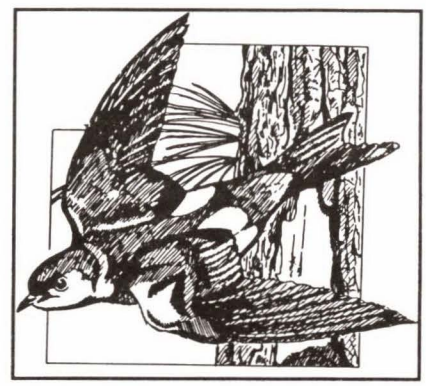
Changes in Tree Density

Studies show that grazing generally leads to an increase in the density of ponderosa pines in the Southwest. The reduction in grass and other understory vegetation reduces competition for pine seedlings, and hence more seedlings are established. Since many bird species in ponderosa pine forests prefer more open woods, populations of these birds may begin to decrease.

Riparian Zones

Riparian zones in the Southwest are also important habitats for breeding birds. More species and individuals are often found in riparian areas than in surrounding vegetation. Grazing, particularly since cattle selectively forage in riparian zones, can change the composition and structure of these unique communities.

Heavy grazing can reduce regeneration of deciduous native trees, altering plant species composition and age structure, and encouraging invasion of aggressive alien plants. These alterations in vegetation may greatly affect bird communities.



Violet-green swallow.

Summary

Southwestern ponderosa pine forest bird species that historically preferred open, park-like forests are likely to be negatively affected by contemporary forest management that emphasizes continuous or long-term grazing in combination with fire exclusion because these practices produce a closed forest of dense, young to mid-aged trees with few grasses, forbs, or shrubs. Mid successional stages dominate contemporary Southwestern ponderosa pine forests and are probably used to the greatest extent by bird species adapted to a broad range of forest and structural types. They may be avoided by species that require special habitat elements only found in open forests, old growth, burns, snags, heterogeneous landscapes, or a combination of these.

However, researchers point out that no bird species of Southwestern ponderosa pine forests has gone extinct since early turn-of-the-century surveys. This may suggest that habitat changes caused by forest management have not been so extreme as to eliminate any species.

Research Needs

The effects of fire, logging, and grazing on bird communites in these forests need further study, researchers conclude. "Probably the most critical research need is to understand the interactive effects of fire, logging, and grazing," say Finch and Ganey. "Evaluating interactive effects will require complex study designs, appropriate funding, close working relationships between management and research, and a large team of scientists, land managers, and technical support staff," they say.

If you would like to know more about research on birds in Southwestern ponderosa pine forests, a new publication has been issued by the Rocky Mountain Research Station titled, *Songbird Ecology in Southwestern Ponderosa Pine Forests: A Literature Review*, General Technical Report RM-292. You can receive a free copy by using the ordering card near the back of this issue of Forestry Research West. Supplies are limited. Deborah Finch can be contacted by writing to her at: USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory, 2205 Columbia S.E., Albuquerque, NM 87106; DG: D.Finch:S28L01A. Joseph Ganey can be reached at: USDA Forest Service, Southwest Forest Science Complex, 2500 S. Pine Knoll, Flagstaff, AZ 86001; DG: J.Ganey:S28L02A.

Trees and Logs Important for Wildlife Habitat

by Sherri Richardson, Pacific Northwest Research Station

Hollow chambers in logs are used by many wildlife species, including the American marten, shown here.

There is an old forest management adage: "If it's got 'toe, it's gotta go!" Traditional forestry meant removing all trees with any signs of infection. That tradition also meant that dead wood on a forest floor was viewed as just that: dead wood. Something that had no use. But recent research has shown wildlife uses dead wood, mistletoe brooms, and decayed trees for nesting and foraging.

Research Wildlife Biologist Evelyn Bull and her colleagues at the Pacific Northwest Research Station examine the use of decayed wood by wildlife in two recent publications: *Trees and Logs Important to Wildlife in the Interior Columbia River Basin* and the *Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin.*

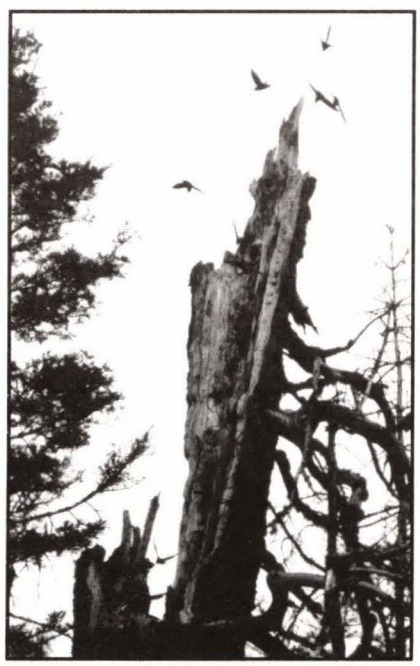
Bull, Research Pathologist Catherine Parks, and Research Entomologist Torolf Torgersen compiled the publications as a result of their past research and the current research they have been conducting in the Blue Mountains in northeastern Oregon.

"Research on snags, woodpeckers, Vaux's swifts, American martens, and other cavity nesters has been ongoing for almost three decades," explained Bull about why the publications were produced. "The initial approach was to identify habitat requirements of individual species of woodpeckers and forest owls. The research was expanded to include additional species of cavity nesters, the ecology of snags, and methods of killing trees."

Although Bull conducted the first phase of the snag research, she says the study has become more integrated with the work of Parks and Torgersen. "Parks has been investigating the inoculation of live trees to form pockets of decay that woodpeckers can use for cavity excavation," Bull says. "Torgersen has been investigating wildlife use of logs, characteristics of individual logs, and log resources on a stand level. This information has been incorporated with his past research on spruce budworm and the influence ants, a log-dwelling species, have on controlling forest insect pests."

Value of Trees and Logs for Wildlife

Hollow trees, trees with brooms, snags, and logs in the interior Columbia River basin are home to more than 80 species of birds, mammals, reptiles, and amphibians. The research information focuses on coniferous forest lands in the basin: the area east of the crest of the Cascade Range in Oregon and Washington, all of Idaho, and a portion of western Montana.



Vaux's Swifts entering a hollow tree being used as a roost.

There are five types of structures discussed in the publication that are of value to wildlife: living trees with decay (such as internal decay), hollow trees, trees with brooms (misshapen branches), dead trees (snags), and down woody material (logs).

"The idea of inoculating living trees to provide suitably decayed trees for woodpeckers to nest in," Parks says, "originated from observations that wilderness (unmanaged forests) had many living trees that contained heartrot, whereas managed forests rarely had trees with heartrot. In wilderness, woodpecker nests were frequently observed in not only dead trees but living trees if they had heartrot."

Heartrot fungi decays the interior of a tree, but the outer cylinder stays sound and the tree may continue to live for hundreds of years, adds Parks. "Traditional forestry practices have removed trees with heartrot as 'culls' and have harvested stands before the trees were old enough to contain decay columns. This methodology was to prevent loss of lumber volume at harvest."

Ecosystem management objectives challenge forest managers to bring back some heartrot decay into managed forests. "Managers are now marking some dead trees and trees with heartrot to be left on the site at the time of stand harvest. Unfortunately, in many stands, these structures have already been removed in the past so it is not possible to retain them now. That sparked the idea of using inoculation as a tool to make nesting habitat," Parks says.

Hollow trees, both living and dead, have just recently been recognized for their value to wildlife habitat. Black bears often use hollow trees with broken tops as sites for dens. The dens sometimes provide protection for female bears and young bears from large, male bears. Hollow logs are homes to other wildlife as well: pileated woodpeckers, northern flickers, Vaux's swifts, American martens, flying squirrels, bats, bushy-tailed woodrats, and other small mammals. The trees that most often develop hollow interiors are grand fir, western larch, and western redcedar.

Broomed Trees as a Wildlife Refuge

Misshapened branches of witches' brooms sometimes found in conifers have long provided homes for wildlife. Brooming is often caused by dwarf mistletoes, broom rusts, or a needle cast fungus. Dwarf mistletoes are perennial parasitic plants that take water and nutrition from their hosts. Once the tree is infected, distinctive shoots on swollen branches become witches' brooms after many years.

Infected trees often are beneficial to wildlife. Certain wildlife species consume mistletoe shoots and fruits, forage for insects in mistletoe plants and brooms, and use witches' brooms for cover and as nesting sites. Because the brooms often occur in various shapes and sizes, their appeal varies to different forms of wildlife.

Raptors like to nest in brooms that form platforms. Brooms are also favorite nesting sites for northern spotted owls, long-eared owls, goshawks, Cooper's hawks, and some song birds.

"When selecting infected trees for wildlife use, we believe that choosing groups of lightly infected trees, where the brooms appear large and dense enough to furnish a nesting platform, will provide the most benefits to wildlife," says Parks.

Dead Trees or Snags Are Essential Too

Snags, or standing dead trees are used by many wildlife species dependant on dead trees for nesting, roosting, denning, foraging, resting, or shelter. Woodpeckers and nuthatches are primary cavity nesters. Other forms of wildlife that cannot excavate a cavity often will use the ones made by woodpeckers who usually make a new nest annually.

Loose bark on snags is sometimes used by brown creepers and bats for nest sites. Other snag users are owls because they are not nest builders. Smaller owls use existing cavities, and larger forest owls use platforms.

When deciding which snags to retain on a managed site, characteristics to consider are tree species, diameter, height, structural class, and proximity to other snags and live trees. The kind of snags retained depends on management objectives and the snag resource available. For instance, if the objective is to provide rest sites for martens, then hollow grand fir and western larch snags would be retained.

Down Woody Material a Useful Component

Natural processes in a forest--breakage, falling trees, windstorms, fires, and floods—all contribute to logs or down woody material collecting on a forest floor. Logs are used by animals for foraging or may provide protection.

Small mammals, amphibians, and reptiles use smaller fallen logs as escape cover and shelter. Hollow logs are used by black bears and martins for dens. Slash piles left after harvest benefit rodents, hares, and rabbits.

"People have often viewed dead wood as waste," said Research Entomologist Torolf Torgersen. "The view is that you have to remove it, when in fact the dead wood really enhances a site."

Torgersen's research has focused on the influence ants, a log-dwelling species, have in controlling forest insect pests. The research has shown that it is difficult to determine if the wildlife use of a log is related to the species or to the size of the log. Lodgepole pine, for example, that had the smallest mean diameters of logs, rarely attracted wood-dwelling ants used as food by pileated woodpeckers. But larch, Douglas-fir, and grand fir, which had the largest mean diameters, were big attractors of these ants.

How to Identify Snags and Logs

Land managers and land owners are discovering that dead trees and logs are a critical part of the forest ecosystem. But how do you determine the species of a dead tree or log when some or all of the branches, cones, or bark are missing? Parks, Bull, and Torgersen's *Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin,*

Hollow logs are used by wildlife as sites for deering, overwintering, food caching, and resting.

contains descriptions and color photographs of snags and logs of 10 coniferous and 3 deciduous tree species found in the interior Columbia River basin. Wildlife use of the different species of snags and logs is also included. "The evidence that dead wood and logs are a critical part of the forest ecosystem is so compelling that managers are easily accepting new management concepts that include retaining down wood," Parks says.

For copies of the two publications, contact the PNW Research Station publications department at (503) 808-2138, or write PNW Research Station Publications Department, P.O. Box 3890, Portland, Oregon 97208-3890. To order via e-mail, send your request to desmith/r6pnw@fs.fed.us and ask for PNW-GTR-390 and PNW-GTR-391, or use the order card in back of this issue.

New from Research

In May, 1997, the USDA Forest Service's Rocky Mountain Forest and Range Experiment Station and the Intermountain Research Station merged into what is now the Rocky Mountain Research Station, headquartered in Fort Collins, Colorado.

Spanning 14 states and over one-third of the Nation, the Rocky Mountain Research Station (RMRS) covers a mixed geographical, social, and economic territory, stretching from the Great Plains to western Nevada, and from the Canadian to Mexican borders.

Scientists at 14 laboratories conduct research on a variety of fronts:

1) **Integrated Adaptive Management Strategies**: Improving the ability to continually adjust resource management strategies as ecological understanding develops through research and monitoring.

2) **Inventory and Monitoring Methods**: Providing new technology to reduce the cost and expand the utility of resource inventory and monitoring.

3) **Restoration of Disturbed Lands**: Establishing on severely disturbed lands dynamic communities that include soil, water, plant, and animal components that represent the naturally diverse ecosystem.

4) **Water, Riparian, and Aquatic Ecosystems**: Developing a better understanding of the dynamics of an ecosystem that affect the quantity and quality of water and the cumulative effects of land management disturbances on native fisheries.

5) **Vegetation Ecology and Management**: Helping land managers understand and sustain the ecological diversity, productivity, and sustainability of native plant communities.

6) **Human Dimensions**: Investigating the relationships between people and their natural resources, and the present and historic role human culture plays in ecosystems.

7) **Disturbance Ecology**: Learning how to anticipate and manage insects, disease, fire, and other disturbances in ecosystems.

8) **Fire Research**: Developing technology and computerized fire behavior models that save lives, private property, and forest resources; and advancing knowledge about fire in nature.

9) **Air Quality**: Determining how forest ecosystems respond to atmospheric factors such as air pollution, and how smoke from forest and range fires may contribute to global change.

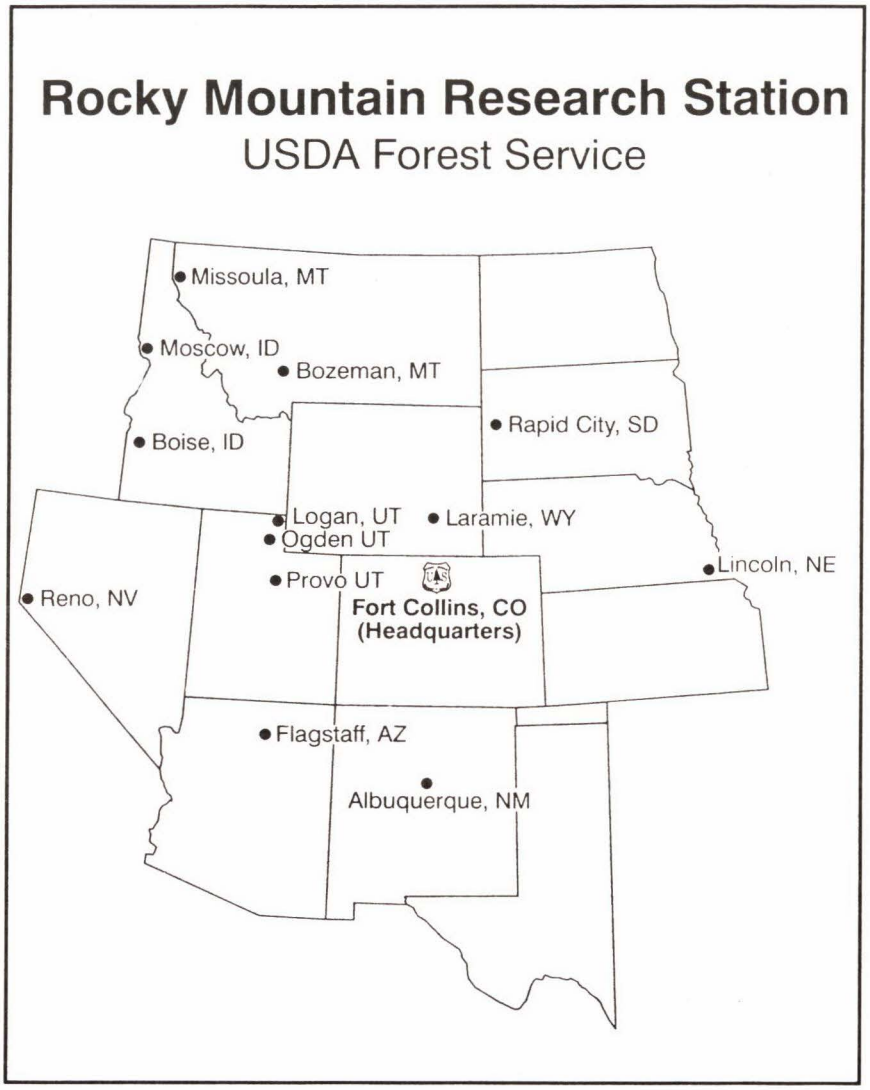
10) **Wilderness Research**: Continuing world leadership in the development of a scientific basis to protect and restore wilderness ecosystems.

11) **Experimental Areas**: Administering and conducting research on 14 Experimental Forests, Ranges, and Watersheds, and maintaining long-term ecological data bases in these areas; overseeing scientific activities on more than 200 Research Natural Areas.

12) **Ecosystem Management and Research Demonstration Areas**: Leading five partnership ecosystem management and research projects in Arizona, Colorado, Montana, New Mexico, and Nevada.

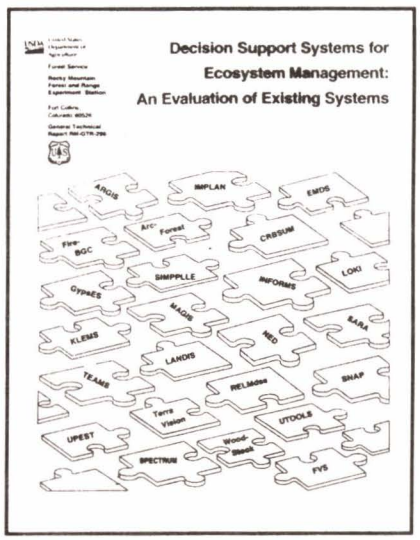
If you would like to receive a free quarterly listing of new scientific publications issued by the Station, or would like more information about RMRS, write:

Rocky Mountain Research Station
Public Affairs
240 West Prospect Rd.
Fort Collins, CO 80526



Dots represent field laboratories.

Decision Support Systems for Ecosystem Management



This report evaluates 24 computer-aided decision support systems (DSS) that can support management decision-making in forest ecosystems. It compares the scope of each system, spatial capabilities, computational methods, development status, input and output requirements, user support availability, and system performance.

Questionnaire responses from the DSS developers provide the basis for four summary tables comparing system capabilities. The responses are also presented verbatim for reference. This evaluation aids potential users of DSS in determining which system most closely fulfills their needs. Limited supplies of *Decision Support Systems for Ecosystem Management: An Evaluation of Existing Systems*, is available from the Rocky Mountain Research Station as General Technical Report RM-296.

Assessing the Sacramento Mountain Salamander

A new Rocky Mountain Research Station report synthesizes existing information on the Sacramento Mountain salamander, a terrestrial amphibian endemic to three mountain ranges in southern New Mexico. The salamander is found in mixed-conifer forests primarily on USDA Forest Service lands, within and under decayed logs, and beneath rocks and litter. Because it depends on a moist microhabitat, it is vulnerable to actions that directly or indirectly reduce the amount of moisture available to it. This assessment will assist land managers in making informed evaluations regarding consequences of management decisions and guide them toward a coordinated approach in the context of ecosystem management. Copies of *Conservation Assessment of the Sacramento Mountain Salamander,* General Technical Report RM-293, are available from the Rocky Mountain Research Station while supplies last.

To order any of the publications listed in this issue of Forestry Research West, use the order cards below. All cards require postage. Please remember to use your Zip Code on the return address.

Please send the following Pacific Northwest Station publications:
(Circle the number)

1) *Trees and Logs Important to Wildlife in the Interior Columbia River Basin*, General Technical Report PNW-391.

2) *Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin*, General Technical Report PNW-390.

3) *Variation in Salmonid Life Histories: Patterns and Perspectives*, Research Paper PNW-498.

4) Other_____

Send to: _____

_____

_____

Please send the following Rocky Mountain Research Station (Fort Collins, CO) publications:
(Circle the number)

1) *Songbird Ecology in Southwestern Ponderosa Pine Forests: A Literature Review*, General Technical Report RM-292.

2) *Decision Support Systems for Ecosystem Management: An Evaluation of Existing Systems*, General Technical Report RM-296.

3) *Conservation Assessment of the Sacramento Mountain Salamander*, General Technical Report RM-293.

4) *A Screening Procedure to Evaluate Air Pollution Effects in Region 1 Wilderness Areas, 1991*, General Technical Report RM-294.

Send to: _____

_____

_____

Please send the following Rocky Mountain Station (Ogden, UT) publications:
(Circle the number)

1)
Other_____

Send to: _____

_____

_____

Please send the following Pacific Southwest Station publications:
(Circle the number)

1) Other

_____

Send to: _____

_____

_____

FORESTRY RESEARCH WEST
U.S. Department of Agriculture
Forest Service
240 West Prospect Rd.
Fort Collins, Colorado 80526

Official Business
Penalty for Private Use, $300

BULK RATE
POSTAGE & FEES PAID
USDA – FS
Permit No. G-40